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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/544,129	08/02/2005	Satoshi Takei	124936	8585

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EXAMINER	
EOFF, ANCA	
ART UNIT	PAPER NUMBER
1795	

NOTIFICATION DATE	DELIVERY MODE
03/10/2010	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/544,129	TAKEI ET AL.	
	Examiner	Art Unit	
	ANCA EOFF	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *12/11/2010*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,2 and 6-10* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,2 and 6-10* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1, 2 and 6-10 are pending in the application. Claims 3-5 have been canceled.

2. The foreign priority document JP 2003-044045, filed on February 21, 2003 was received and acknowledged. However, in order to benefit of the earlier filing date, a certified English translation is required.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1, 2, 6 and 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Takei et al. (WO 02/05035, wherein the citations are from the English equivalent document, US Pg-Pub 2003/0146416).

With regard to claims 1, Takei et al. disclose a composition for forming a gap-filling material for lithography, wherein said material is used for producing semiconductor devices by a method using the gap filling material to apply the resist on a substrate having holes with an aspect ratio of 1 or more, to transfer images onto the substrate by utilization of lithographic process (abstract). The composition for forming a gap-filling material comprises a polymer, a solvent (abstract) and a crosslinking agent (par.0095).

Takei et al. further disclose that the polymer is preferably a polymer that contains at least one or more hydroxyl groups per repeating unit. Examples thereof include polymers obtained by polymerizing compounds such as hydroxyalkyl acrylates or hydroxyalkyl methacrylates (par.0061).

As hydroxyalkyl acrylates, Takei et al. specifically disclose:

- hydroxyethyl acrylate (par.0064), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a hydrogen atom, p=1, q=0 and R_2 is a hydrogen atom;

- hydroxypropyl acrylate (par.0064), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a hydrogen atom, p=2, q=0 and R_2 is a hydrogen atom, and

- hydroxybutyl acrylate (par.0064), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a hydrogen atom, p=3, q=0 and R_2 is a hydrogen atom.

As hydroxyalkyl methacrylates, Takei et al. specifically disclose:

-hydroxyethyl acrylate (par.0065), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a methyl group, p=1, q=0 and R_2 is a hydrogen atom;

- hydroxypropyl acrylate (par.0065), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a methyl group, p=2, q=0 and R_2 is a hydrogen atom, and

- hydroxybutyl acrylate(par.0065), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a methyl group, p=3, q=0 and R_2 is a hydrogen atom.

Takei et al. further disclose that the weight average molecular weight of the polymer is preferably between 1,000 and 30,000 (par.0060), which encompasses the range for molecular weight of the instant application.

Takei et al. do not specifically disclose a polymer comprising only units derived from the hydroxyalkyl (meth)acrylates mentioned above and having the weight molecular weight in the range of 5,000 to 20,000. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to obtain such a polymer, based on Takei's teachings that polymers comprising at least one hydroxyl group per repeating unit may be obtained by polymerizing hydroxyalkyl (meth)acrylates (par.0061) and the teaching regarding the preferred weight average molecular weight of the polymers (par.0060).

In Synthetic Examples 2 and 3 (par.0019 and par.0123), Takei et al. disclose polymers having weight average molecular weights of 5,300 and respectively 19,000. Therefore, one of ordinary skill in the art at the time of the invention would have been motivated to obtain polymers with weight average molecular weights in this range. Such polymers would satisfy the limitation of "containing components having a molecular weight of 3,000 or less in a rate of 20% or less".

Takei et al. disclose that the solvent used for the composition for forming gap-filling material preferably has a boiling point in the range of 145-220^{o}C (par.0098) and

may be butyl lactate, cyclohexanone, propylene glycol monobutyl ether or propylene glycol monomethyl ether acetate (par.0097).

With regard to claim 2, Takei et al. disclose a composition for forming a gap-filling material for lithography, wherein said material is used for producing semiconductor devices by a method using the gap filling material to cover the resist on a substrate having holes with an aspect ratio of 1 or more, to transfer images onto the substrate by utilization of lithographic process (abstract). The composition for forming a gap-filling material comprises a polymer, a solvent (abstract) and a crosslinking agent (par.0095).

Takei et al. further disclose that the polymer is preferably a polymer that contains at least one or more hydroxyl groups per repeating unit and examples thereof include thermoplastic polymers obtained by polymerizing compounds such as hydroxyalkyl acrylates or hydroxyalkyl methacrylates (par.0061).

As hydroxyalkyl acrylates, Takei et al. specifically disclose:

- hydroxyethyl acrylate (par.0064), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a hydrogen atom, p=1, q=0 and R_2 is a hydrogen atom;

- hydroxypropyl acrylate (par.0064), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a hydrogen atom, p=2, q=0 and R_2 is a hydrogen atom, and

- hydroxybutyl acrylate (par.0064), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a hydrogen atom, p=3, q=0 and R_2 is a hydrogen atom.

As hydroxyalkyl methacrylates, Takei et al. specifically disclose:

-hydroxyethyl acrylate (par.0065), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a methyl group, p=1, q=0 and R_2 is a hydrogen atom;

- hydroxypropyl acrylate (par.0065), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a methyl group, p=2, q=0 and R_2 is a hydrogen atom, and

- hydroxybutyl acrylate(par.0065), which is equivalent to the compound of formula (1) of the instant application, wherein R_1 is a methyl group, p=3, q=0 and R_2 is a hydrogen atom.

Takei et al. further disclose that the above-mentioned polymer can be copolymerized with an uncrosslinkable monomer, so that the dry-etching speed and reflectivity can be finely adjusted and such co-polymerizable monomer includes alkyl acrylates and alkyl methacrylates having alkyl groups of 1 to 10 carbon atoms (par.0071 and par.0073-0074).

Takei et al. further disclose that the weight average molecular weight of the polymer is preferably between 1,000 and 30,000 (par.0060), which encompasses the range of the instant application.

While Takei et al. do not specifically disclose a polymer comprising only units derived from the hydroxyalkyl (meth)acrylates and the alkyl (meth)acrylates and having the wieight molecular weight in the range of 5,000 to 20,000, it would have been obvious to one of ordinary skill in the art at the time of the invention to obtain such a

polymer, based on Takei's teachings that polymers comprising at least one hydroxyl group per repeating unit may be obtain by co-polymerizing hydroxyalkyl (meth) acrylates (par.0061) with uncrosslinkable monomers, such as alkyl (meth) acrylates in order to finely adjust the reflectivity and dry etching speed (par.0071) and the teaching regarding the preferred weight average molecular weight of the polymers (par.0060).

Takei et al. further disclose that the repeating unit which comprises a hydroxyl group may represent 20-80% of the repeating units of the polymers (par.0090-0093) and gives examples wherein the repeating unit which comprises a hydroxyl group represents 70% molar (par.0016) and respectively 49% molar (par.0120).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to obtain polymer comprising a repeating unit containing a hydroxyl group in an amount preferably between 20-80% of the repeating units of the polymer, wherein the repeating unit containing a hydroxyl group may be hydroxyalkyl (meth) acrylates.

In Synthetic Examples 2 and 3 (par.0019 and par.0123), Takei et al. disclose polymers having weight average molecular weights of 5,300 and respectively 19,000. Therefore, one of ordinary skill in the art at the time of the invention would have been motivated to obtain polymers with weight average molecular weights in this range. Such polymers would satisfy the limitation of "containing components having a molecular weight of 3,000 or less in a rate of 20% or less".

Takei et al. disclose that the solvent used for the composition for forming gap-filling material preferably has a boiling point in the range of 145-220^{o}C (par.0098) and

may be butyl lactate, cyclohexanone, propylene glycol monobutyl ether or propylene glycol monomethyl ether acetate (par.0097).

With regard to claim 6, Takei et al. disclose that the crosslinker used for the composition for forming gap-filling material has at least two cross-linking forming functional groups (par.0095).

With regard to claims 8-10, Takei et al. disclose a semiconductor device manufacturing method comprising the following steps:

-a step (A) in which the composition for gap-filling material is applied to a substrate having holes with an aspect ratio or 1 or above and then is dried to form a planarized filling layer on the substrate (par.0107);

- a step (B) in which the resist is applied and dried (par.01018), and

- a step (C) in which an exposure and development are performed (par.0109).

Takei et al. also disclose that a bottom anti-reflective coating can be formed before or after the formation of the filling layer using the composition for forming gap-filling material in the above step (A) (par.0109).

5. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Takei et al. (WO 02/05035, wherein the citations are from the English equivalent document, US Pg-Pub 2003/0146416) as applied to claim 1 above and in further view of Rutter et al. (US Pg-Pub 2002/0110665).

With regard to claim 7, Takei et al. teach the composition for forming a gap-filling material of claim 1 (see paragraph 4 of the Office Action) but fail to teach that the composition comprises an acid or an acid generator.

Rutter et al. disclose an aperture fill material, comprising a cross-linkable polymer with hydroxyl groups, one or more crosslinking agents, one or more acid catalysts and a solvent (par.0026).

The acid catalysts are added to the composition to catalyze the crosslinking of the polymer and crosslinking agent (par.0051) and may be free acids or acid generators.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to include the acid catalysts (free acid or acid generators) disclosed by Rutter et al. in the composition for forming a gap-filling material of Takei et al., in order to catalyze the crosslinking of the polymer and crosslinking agent.

Response to Arguments

6. Applicant's arguments filed on December 11, 2009 have been fully considered but they are not persuasive.

On page 4 of the Remarks, the applicant argues that Takei et al. teach polyhydroxypropyl methacrylate copolymerized with 4-methoxyphenol (par.0127) and do not teach the sole use of polyhydroxypropyl methacrylate. The applicant further argues that the preferable polymers include homopolymers of hydroxystyrene (vinyl

phenol) and copolymers of vinylphenol with other additional monomers. The applicant further argues that the embodiments of Takei necessarily contain vinylphenol.

The examiner would like to show that in par.0127, the 4-methoxyphenol is not another monomer but a polymerization terminator. The Synthetic Example 4 in par.0127 shows a poly(hydroxypropyl methacrylate) polymer with a weight-average molecular weight of 130,000. This example shows a polymer having as sole unit hydroxypropyl methacrylate.

This example is used by Takei et al. to prove that the high weight-average molecular weight leads to high viscosity and inferior results (see Comparative Example 3 in par.0147 and par.0163).

The examiner would like to show that Takei et al. teach that the gap-filling material comprises a polymer, wherein the polymer should have a weight-average molecular weight between 500 and 30,000 (see par.0020 and par.0060). Takei et al. further teach that the polymer is preferably a polymer that contains at least 1 or more hydroxyl groups, which are cross-linking forming functional groups, per repeating unit (see par.0061). The polymers may be obtained by polymerizing compounds having one addition-polymerization unsaturated bond in a molecule, such as hydroxyalkyl acrylates and hydroxyalkyl methacrylates (see par.0061).

The hydroxyalkyl acrylates and methacrylates are two out of seven types of resins taught by Takeda et al. so one of ordinary skill in the art would be motivated to use a polymer derived from hydroxyalkyl acrylates and methacrylates for the gap-filling material, with a reasonable expectation of success.

Furthermore, Takei et al. teach that the hydroxyalkyl acrylates include hydroxyethyl acrylate, hydroxypropyl acrylate and hydroxybutyl acrylate (part.0064).

Takei et al. teach that the hydroxyalkyl methacrylates include hydroxyethyl methacrylate, hydroxypropyl methacrylate and hydroxybutyl methacrylate (part.0064).

These hydroxyalkyl (meth)acrylates are clearly taught by Takei so one of ordinary skill in the art would be motivated to use polymers derived from these hydroxyalkyl (meth)acrylates. Homopolymers derived from the hydroxyalkyl (meth)acrylates of Takei et al. meet the limitations of claim 1.

Takei et al. further shows that the polymers contains at least 1 or more hydroxyl groups, which are cross-linking forming functional groups, per repeating unit may comprise additional monomers , in order to adjust the dry etching speed and reflectivity (par.0071-0082).Examples of such additional monomers include (meth)acrylic esters (par.0073-0074).

Copolymers comprising repeating units of hydroxyalkyl (meth)acrylates and (meth)acrylic esters meet the limitations of claim 2.

The examiner agrees that Takei shows polymers comprising hydroxystyrene/vinyl phenol units(par.0021-0036). Takei et al. teaches that such polymers are preferred (see par.0083) but does not exclude the other polymers from being used in the gap-filling material.

On pages 4-5 of the Remarks, the applicant argues that the Comparative Examples of Takei show that the acrylic polymers should not be used, at least without polymerization, based on their planarizing ability.

The examiner respectfully disagrees and would like to show that Takei et al. clearly shows that the inferior results in Comparative Examples 2-3 are given by the high value of viscosity and not by the polymer (see par.0163).

Also, Takei et al. shows that the inferior results in Comparative Examples 4-5 are given by the solvent (see par.0165).

The Comparative Example 1 uses polyethylene glycol, which is not included on Takei's list of polymers with at least 1 hydroxyl group in each repeating unit (see par.0061-0070).

Therefore, it is the examiner's position that Takei et al. do not discourage from using other polymers than the ones with hydroxystyrene/vinyl phenol units, as the applicant argues.

On pages 5-6 of the Remarks, the applicant argues that Rutter et al. do not cure the defficiencies of Takei regarding claims 1 and 2.

The examiner would like to point out that Rutter et al. was only relied on to show that an aperture fill material may comprise not only a polymer with hydroxyl groups and one or more crosslinking agents but also an acid catalyst, which catalyzes the crosslinking of the polymer and crosslinking agent.

Conclusion

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to ANCA EOFF whose telephone number is (571)272-9810. The examiner can normally be reached on Monday-Friday, 6:30 AM-4:00 PM, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cynthia H. Kelly can be reached on 571-272-1526. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a

USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/A. E./
Examiner, Art Unit 1795

/Cynthia H Kelly/
Supervisory Patent Examiner, Art Unit 1795